

WHAT IS CLAIMED IS:

- 1 1. A method for extracting information transmitted by a desired user in a communications
2 system from a received signal in the presence of interferers comprising:
3 derotating the received signal;
4 determining channel estimates and detecting the presence of interferers; and
5 extracting information transmitted by the desired user from the received signal.
- 1 2. The method of claim 1 further comprising prior to the derotating, sampling the received
2 signal at a given sampling rate.
- 1 3. The method of claim 2, wherein the received signal is transmitted at a symbol rate, and
2 wherein the sampling rate is essentially equal to the symbol rate.
- 1 4. The method of claim 2, wherein the received signal is transmitted at a symbol rate, and
2 wherein the sampling rate is higher than the symbol rate.
- 1 5. The method of claim 1, wherein the determining comprises:
2 generating a list of hypotheses;
3 computing an error variance for each hypothesis in the list of hypotheses;
4 selecting a hypothesis associated with a smallest computed error variance; and
5 computing channel estimates from the selected hypothesis.
- 1 6. The method of claim 5, wherein a hypothesis contains information about a desired user
2 and any expected interferers.
- 1 7. The method of claim 6, wherein a hypothesis further contains timing offset information.

1 8. The method of claim 1, wherein the determining provides a number of users transmitting
2 in the communications system, wherein the number of users provided by the determining
3 includes the desired user, and wherein the extracting comprises:

4 for each user,

5 computing transmitted symbols;

6 computing contribution of the transmitted symbols from the user;

7 removing the computed contribution from the received signal; and

8 the method further comprising,

9 recomputing the transmitted symbols from the desired user.

1 9. The method of claim 8, wherein the first computing comprises applying a channel
2 estimate for the user to the received signal.

1 10. The method of claim 9, wherein an equalizer is used to apply the channel estimate to the
2 received signal.

1 11. The method of claim 8, wherein the second computing comprises multiplying the
2 computed transmitted symbols with a channel estimate for the user.

1 12. The method of claim 8, wherein the desired user is a first user whose computed
2 contribution is subtracted from the received signal, and wherein the recomputing comprises:
3 combining a received signal with the computed contribution from the first user removed
4 with a received signal with the computed contributions from each user removed; and
5 applying a channel estimate for the first user to the combined received signal.

1 13. The method of claim 12, wherein the applying is performed by an equalizer.

- 1 14. The method of claim 8, wherein ordering of the users is performed.
- 1 15. The method of claim 14, wherein the ordering is based on a numbering of the users.
- 1 16. The method of claim 14, wherein the ordering is based on the users' channel energy.
- 1 17. The method of claim 14, wherein the ordering is based on SIR.
- 1 18. The method of claim 14, wherein the ordering is based on SINR.
- 1 19. The method of claim 8, wherein the extracting can be repeated for the same set of
2 transmitted symbols.
- 1 20. The method of claim 1, wherein the determining provides a number of users transmitting
2 in the communications system, and wherein the extracting comprises:
3 applying the received signal to a plurality of matched filters, wherein there is one
4 matched filter per number of users;
5 providing outputs from the plurality of matched filters to a first decision feedback
6 multiuser equalizer to compute an initial estimate of the information;
7 providing outputs from the plurality of matched filters to a sequentially connected series
8 of N decision feedback multiuser equalizers, wherein each decision feedback multiuser equalizer
9 computes an intermediate estimate of the information based on an output of a previous decision
10 feedback multiuser equalizer and a correlation;
11 wherein N is an integer number representing a number of estimates of the information
12 desired, and wherein output of the N-th decision feedback multiuser equalizer is the information.

- 1 21. The method of claim 20, wherein the number of matched filters is equal to a maximum
2 number of unique users in the communications system.
- 1 22. The method of claim 20 further comprising extracting a real component of the outputs
2 from the plurality of matched filters.

1 23. A receiver comprising:
2 a sampling unit coupled to a signal input, the sampling unit containing circuitry to sample
3 a received signal provided by the signal input at a specified sampling rate;
4 a channel estimation unit coupled to the sampling unit, the channel estimation unit
5 containing circuitry to determine a number of users present in the received signal and to compute
6 channel estimates for each user; and
7 a multiuser detection unit coupled to the channel estimation unit, the multiuser detection
8 unit containing circuitry to extract information transmitted by a desired user from the received
9 signal.

1 24. The receiver of claim 23, wherein the multiuser detection unit can extract the information
2 transmitted by the desired user in a single iteration, and wherein to improve upon the quality of
3 the extracted information, the multiuser detection unit can repeatedly iterate on the received
4 signal.

1 25. The receiver of claim 24, wherein the multiuser detection unit repeatedly iterates on the
2 same received signal.

1 26. The receiver of claim 23 further comprising a derotation unit having an input coupled to
2 the sampling unit and an output coupled to the channel estimation unit and the multiuser
3 detection unit, the derotation unit containing circuitry to apply a rotation of a specified amount to
4 the sampled received signal.

1 27. The receiver of claim 23, wherein the multiuser detection unit comprises:
2 a plurality of transmit symbol compute units coupled in a sequential fashion to a channel
3 estimation unit, each symbol compute unit comprising,

4 an equalizer containing circuitry to apply a channel estimate to an input signal to
5 compute transmitted symbols for a user, wherein the input signal is the derotated sampled
6 received signal if the transmit symbol compute unit is the first of the plurality, else the input
7 signal is an output of a previous transmit symbol compute unit;
8 a convolution unit coupled to the equalizer, the convolution unit to convolve an
9 output of the equalizer with the channel estimate; and
10 a summing point coupled to the input signal and the multiplier, the summing point
11 to subtract an output of the convolution unit from the input signal;
12 a final summing point coupled to an output of a final transmit symbol compute unit from
13 the plurality and an output of the convolution unit from the first transmit symbol compute unit,
14 the final summing point to add the two signals; and
15 a final equalizer coupled to the final summing point, the final equalizer to re-estimate the
16 information transmitted by the desired user.

1 28. The receiver of claim 27, wherein there are as many transmit symbol compute units as
2 there are unique users.

1 29. The receiver of claim 23, wherein the multiuser detection unit comprises:

2 a plurality of matched filters coupled to a signal input line, each matched filter to apply a
3 channel estimate for a unique user to a signal provided by the signal input line;

4 a first decision feedback multiuser equalizer coupled to outputs of the plurality of
5 matched filters, the first decision feedback multiuser equalizer containing circuitry to compute an
6 initial estimate of the information transmitted by the desired user;

7 a correlation unit coupled to the first decision feedback multiuser equalizer, the
8 correlation unit containing circuitry to compute a correlation function based on channel

9 estimates; and
10 a plurality of decision feedback multiuser equalizers serially coupled together, wherein a
11 first of the plurality is coupled to the first decision feedback multiuser equalizer, each decision
12 feedback multiuser equalizer coupled to the outputs of the plurality of matched filters and the
13 correlation unit, each decision feedback multiuser equalizer containing circuitry to compute an
14 intermediate estimate of the information transmitted by the desired user based upon the
15 correlation function, the outputs of the plurality of matched filters, and an output of a previous
16 decision feedback multiuser equalizer.

1 30. The receiver of claim 29, wherein there are N decision feedback multiuser equalizers in
2 the plurality, wherein N is an integer number representing a number of estimates to be
3 performed, and wherein output of the N-th decision feedback multiuser equalizer is the
4 information transmitted by the desired user.

1 31. The receiver of claim 23, wherein the receiver is part of a wireless device used in a
2 synchronous communications system.

1 32. The receiver of claim 31, wherein the synchronous communications system is a GSM
2 compliant communications system.